A Review On Performance Of Concrete Mixes Containing Fly Ash

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Abstract- *The particle sizes in fly ash vary from less than 1 µm (micrometer) to more than 100µm with the typical particle size measuring under 20 µm. Only 10% to 30% of the particles by mass are larger than 45µm.The surface area is typically 300 to 500 m2/kg, although some fly ashes can have surface areas as low as 200 m2/kg and as high as700 m2/kg. For fly ash without close compaction, the bulk density(mass per unit volume including air between particles) can vary from 540 to 860 kg/m3 (34 to 54 lb/ft3), whereas with close packed storage or vibration, the range can be 1120 to1500 kg/m3(70 to 94 lb/ft3).Fly ash is primarily silicate glass containing silica, alumina, iron, and calcium. Minor constituents are magnesium, sulfur, sodium, potassium, and carbon. Crystalline compounds are present in small amounts. The relative density (specific gravity) of fly ash generally ranges between 1.9 and 2.8 and the color is generally gray or tan. And there are two types of fly ash namely Class C fly ash and Class F fly ash.*

The incorporation of coal fly ash can enhance the ability to place, consolidate, and finish fresh concrete; to control the temperature and cracking tendency of recently cast concrete; and to reduce the porosity and penetrability of hardened concrete. These factors result in increased durability that promotes a longer service life and increased sustainability for national infrastructure. If coal fly ash use in concrete decreases, there are no viable alternatives in sufficient volume to meet the demand for concrete with all the benefits as described.

Keywords- Fly ash 1, Aggrgate 2,Sand 3, Concrete 4,

I. INTRODUCTION

Concrete is a mixture of paste and aggregates. Various materials are added such as fly ash, admixture to obtain concrete of desired property. The character of the concrete is determined by quality of the paste. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. The detailed experimental investigation done to study the effect of partial replacement of cement with Fly Ash on cement. In this project I started proportion of Fly ash form 0%, 12.5%, 25% and 37.5%. Mix together in concrete by replacement of cement. Number of tests are performed on wet concrete such as workability tests, compaction factor test and slump test. The tests on hardened concrete are destructive test while the destructive test includes compressive test on concrete cube for size (150 x 150 x 150) mm, Flexural strength on concrete beam (500 x 100 x100) and split tensile strength on concrete cylinder (150 mm ø x 300mm) as per IS: 516 – 1959, IS: 5816 – 1999 and IS: 516 – 1959 respectively. The concrete samples are to be cured for 28 days in normal method for compressive strength.

The work presented in this project reports an investigation on the behavior of concrete produced from partial replacement of Fly Ash. The physical and chemical properties of Fly Ash and OPC were first investigated. Mixture proportioning was performed to produce high workability concrete (200- 240 mm slump) with strength of M20, M25, M30for the control mixture. The effect of FA on concrete properties was studied by means of the fresh properties of concrete and the mechanical properties. i.e. Compressive strength, tensile splitting strength, Flexural strength , and deflection of beam.

1.1 FUNDAMENTALS AND IMPORTANCES OF FLY ASh

Fly ash contributes to a more sustainable, environmentally responsible infrastructure because its use in concrete can:

- reduce concrete’s embodied energy and CO2 footprint;
- lower coal fly ash landfill volumes;
- increase the service life of concrete;
- tie-up trace metals in ash;
- enable the use of local marginal quality sand, crushed stone, and gravel and thus reduce the need to open new quarries and pits; and
- reduce the need and cost for repairs and maintenance.

Fly ash is vital to concrete performance because it can:

- be an effective ingredient in high-strength and high-performance concrete;
- reduce the porosity and penetrability of hardened concrete;
- be an effective ingredient in minimizing corrosion of reinforcing steel;
- be an effective ingredient in resisting severe environmental exposures;
- reduce the heat produced by chemical reaction of the cement (this is critical in dams, bridge piers, and large foundations)
- increase construction quality by making a more compactable concrete;
- lower concrete’s initial and life-cycle cost; and
- reduce the need to import cement

II. CODAL PROVISION

IS:10262-1982 “RECOMMENDED GUIDELINES FOR CONCRETE MIX DESIGN”

Concrete like other engineering materials needs to be designed for properties like strength, durability, workability and cohesion. Concrete mix design is the science of deciding relative proportions of ingredients of concrete, to achieve the desired properties in the most economical way. With advent of high-rise buildings and pre-stressed concrete, use of higher grades of concrete is becoming more common. Even the revised IS 456-2000 advocates use of higher grade of concrete for more severe conditions of exposure, for durability considerations. With advent of new generation admixtures, it is possible to achieve higher grades of concrete with high workability levels economically. Use of mineral admixtures like fly ash, slag, meta kaolin and silica fume have revolutionized the concrete technology by increasing strength and durability of concrete by many folds. Mix design of concrete is becoming more relevant in the above-mentioned scenario.

This standard lays down the recommended procedure for designing concrete mixes for general types of construction using the concreting materials normally available. The design is carried out for a desired compressive strength and workability of concrete, using continuously graded aggregates. This standard does not include the design of concrete mixes for flexural strength or when gap-graded aggregates or various admixtures and pozzolona are to be used.

IS 456-2000, Plain and Reinforced concrete code of practice (fourth revision)

a) In recent years, durability of concrete structures have become the cause of concern to all concrete technologists. This has led to the need to codify the durability requirements world over. This code, in order to introduce in-built protection from factors affecting a structure, earlier clause on durability has been elaborated and a detailed clause covering different aspects of design of durable structure has been corporate.

b) Sampling and acceptance criteria for concrete have been detected in this standard. With this revision acceptance criteria has been simplified in line with the provisions given in BS 5328 (Part 4):1990 ‘Concrete: Part 4 Specification for the procedures to be used in sampling, testing and assessing compliance of concrete. Some of the significant changes incorporated in Section 2 are as follows:

All the three grades of ordinary Portland cement, namely 33 grade, 43 grade and 53 grade and sulphate resisting Portland cement have been included in the list of types of cement used (in addition to other types of cement). The permissible limits for solids in water have been modified keeping in view the durability requirements .The clause on admixtures has been modified in view of the availability of new types of admixtures including superplasticixers.

In this standard, Table 2 ‘Grades of Concrete’, grades higher than M 40 have been a) In recent years, durability of concrete structures have become the cause of concern to all concrete technologists. This has led to the need to codify the durability requirements world over. This code, in order to introduce in-built protection from factors affecting a structure, earlier clause on durability has been elaborated and a detailed clause covering different aspects of design of durable structure has been corporate.It has been recommended that minimum grade of concrete shall be not less than M 20 in reinforced concrete work. In the absence of proper correlation between compacting factor, vee-bee time and slump, workability has now been specified only in terms of slump in line with the provisions in BS 5328 (Parts 1 to 4). Durability clause has been enlarged to include detailed guidance concerning the factors affecting durability. The table on ‘Environmental Exposure Conditions’ has been modified to include ‘very severe’ and ‘extreme’ exposure conditions. This clause also covers requirements for shape and size of member, depth of concrete cover, concrete quality, requirement against exposure to aggressive chemical and sulphate attack, minimum cement requirement and maximum water cement ratio, limits of chloride content, alkali silica reaction, and importance of compaction, finishing and curing. A clause on ‘Quality Assurance Measures’ has been incorporated to give due emphasis to good practices of concreting. Proper limits have been introduced on the accuracy of measuring equipments to ensure accurate batching of concrete.

IS 516-1959, "Method of test for strength of Concrete"

This standard covers tests for the determination of compressive strength, flexural strength and modulus of elasticity of cement concrete. This standard specifies the procedure for making and curing compression test specimens of concrete in the laboratory where accurate control of the quantities of materials and test conditions are possible and where the maximum nominal size of aggregate does not exceed 38 mm. The method is specialy applicable to the making of preliminary compression tests to ascertain the suitability of the available materials or to determine suitable mix proportions.

IS 1199-1959, "Methods of sampling and analysis of Concrete".

This standard covers the methods of taking samples of concrete and their analysis. Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials for concrete as also, the concrete, both while it is fresh and after it has hardened, is an inseparable part of any quality control programmed for concrete. It helps to achieve higher efficiency of the materials used and greater assurance of the performance of the concrete in regard to both strength and durability. The test methods used should be simple, direct and convenient in their application. This standard has been prepared with this object in view and provides a guide to the sampling, analysis, and determination of linear changes of concrete. This standard is intended chiefly to cover the technical provisions relating to sampling and analysis of concrete.

III. CONCLUSIONS

The project achievements are as follows:

- Compressive strength increases with the increase in the percentage of Fly ash up to replacement 37.50% FA of Cement in Concrete for different mix proportions.
- In this project, the review and research of current usage of Fly Ash in the concrete for different sectors is studied, such as for constructions, industries, applications, previous research and investigation are done..
- In this project, Fineness of Fly Ash is Studied.
- As we increase percentage of Fly Ash Slump goes on decreasing.
- The maximum 90 days compressive strength was obtained with 25 % fly ash replacement.
- Present work is aimed at developing predictive tool with respect to normal density aggregate and normal weight concrete. However, the work can be extended to the concrete of light weight and heavy density.

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